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GHOSTS AND GOBLINS.

By RICHARD A. PROCTOR.

(*Continued from page* 95.)

AMONG the most perplexing circumstances in the common belief about ghosts are the accepted ideas about ghostly habilaments. For instance, why should so many ghosts be clothed in white? If the answer is that grave-clothes are white, we may inquire what a ghost wants with grave-clothes? It might as well refuse to appear without a coffin. And then, many ghosts have appeared in their habit as they lived. If we inquire what is the real conception in the ghost-seer's mind as to the nature of the vision, we find a difficulty in understanding what idea is formed by the real believer in ghosts respecting the vestments in which spirits make their appearance. This is an old difficulty. In fact it has probably occurred to every one who has thought over a ghost story. So soon as we come to the description of the ghost's vestments there is always a hitch in the story. For my own part, I must have been a very small child indeed, when I first pondered over the question—Who made the ghost's clothes?

Of course there is no difficulty in the case of those who believe only in ghostly apparitions as phantoms of the brain. Here a distinction must be drawn. I am not speaking of those who regard such apparitions as either due to a diseased action of the brain or to the power of fancy in forming from real objects, indistinctly seen, the picture of a departed friend; but of those who look on visions of the dead as produced by supernatural impressions on the brain. Those who think that at the will of the dead a vision may be caused to appear, can of course understand that this vision would either be clothed in the garb which had been worn during life, or in grave-clothes, or in such other dress as suited the circumstances under which the vision appeared. But this view is not ordinarily adopted by those who regard apparitions as supernatural phenomena. They commonly regard the phantom as something really existent in the place where it is apparently seen. The dead person is *there* in some form; some essential entity representing him has the power to transport itself from the place of the departed into the presence of the living. This ordinary idea of ghostly visions is aptly rendered in Hamlet's address to the ghost. He does not speak *of* it as a vision, but *to* it as something real, although not understood:—

> Be thou a spirit of health or goblin damn'd,
> Bring with thee airs from heaven or blasts from hell,
> Be thy intents wicked or charitable,
> Thou comest in such questionable* shape,
> That I will speak to thee: I'll call thee Hamlet:
> King, father, royal Dane: O, answer me!
> Let me not burst in ignorance; but tell
> Why thy canonized bones, hearsed in death,
> Have burst their cerements; why the sepulchre,
> Wherein we saw thee quietly inurn'd
> Hath oped his ponderous and marble jaws,
> To cast thee up again.

Nor does the poet shrink from investing the ghost with the garb of life. This had been already shown in the first scene. "Such," says Horatio, "was the very armour he had on, when he the ambitious Norway combatted." And now Hamlet asks—

> What may this mean,
> That thou, dead corse, again in complete steel,
> Revisit'st thus the glimpses of the moon,
> Making night hideous; and we fools of nature
> So horridly to shake our disposition
> With thoughts beyond the reaches of our souls?
> Say, why is this? Wherefore? What should we do?

Again, it is curious how thoroughly the conventional idea of a ghost or goblin is associated with the thought of a shrouded face. It may be that this is partly due to the circumstance that while the imagination may quite commonly present to us the idea of a vision in all points complete except in the face, it can be but rarely that real objects are mistaken for the actual features of a deceased friend. Be this as it may, the ghost has been pictured with concealed face from time immemorial. So Flaxman draws the ghost encountered by Ulysses in Hades, and no really fearful ghost has shown its face since the days when fear came upon Eliphaz the Temanite, "and trembling which made all his bones to shake; when a spirit passed before his face and the hair of his flesh stood up; and the spirit stood still; but he *could not discern the form thereof.*"

It is curious that children, when they try to frighten each other by "making ghosts," cover their heads. There is another singular trick they have—they make horns to their heads with their forefingers. Why should horns be regarded as peculiarly horrible? The idea can scarcely be referred to the times of our savage ancestors, for the creatures they had chiefly to fear were certainly not the horned animals. Yet the conventional devil is horned, and moreover, "divideth the hoof," and is therefore a ruminating animal.† Did our savage ancestors keep their children in order by frightening them with stories about their horned cattle? It is likely, at least, that among the most portentous forms known to those children must have been the oxen and goats which formed a principal feature of their surroundings.

It must be admitted that there is something particularly hideous in a long horned face. I remember an instance where the sudden appearance of such a face, or what I took to be such, caused me a degree of discomfort certainly not justified by the occasion. Singularly enough,

* Mistakenly understood generally to signify "doubtful." What is meant is obviously "a shape as of one to whom questions can be addressed."

† The conventional dragon is a Pterodactylian reptile. Ruskin will have it that Turner's picture of the Dragon guarding the Hesperidan apples was a mental evolution of a Saurian reptile; but Turner himself said he got the idea of his dragon at a pantomime at Drury Lane. *Utrum horum mavis accipe.* It is a wide range from the greensand to the greenroom.

the event belonged to the period of my life to which I have already referred; and I may as well note that at no time, either before or since, have I even for a moment (and against the will of the mind) mistaken commonplace objects for either "spirit of health" or "goblin damn'd."

During the last weeks of the long vacation already mentioned I went alone to Blackpool, in Lancashire. There I took lodgings in a house facing the sea. My sitting-room was on the ground-floor. On a warm autumn night I was reading with the window open; but the blind was down, and was waving gently to and fro in the wind. It happened that I was reading a book on demonology; moreover, I had been startled earlier in the evening by prolonged shrieks from an upper room in the house where my landlady's sister, who was very ill, had had an hysterical fit. I had just read to the end of a long and particularly horrible narrative, when I was disturbed by the beating of the curtain—the wind having risen somewhat—and I got up to close the window. As I turned round for the purpose, the curtain rose gently and disclosed a startling object. A fearful face was there, black, long, and hideous, and surmounted by two monstrous horns. Its eyes, large and bright, gleamed horribly, and a mouth garnished with immense teeth grinned at me. Then the curtain slowly descended. But I knew the horrible thing was there. I waited, by no means comfortably, while the curtain fluttered about, showing parts of the black monster. At last it rose again so as to disclose the whole face. But the face had lost its horror for me. For *the horns were gone.* Instead of the two nearly upright horns which before had shown black and frightful against the light background of sea and sky, there were two sloped ears as unmistakably asinine as I felt myself at the moment. When I went to the window (which before I felt unable to approach) I saw that several stray donkeys were wandering through the front gardens of the row of houses to which my lodgings belonged. It is possible that the inquisitive gentleman who had looked in at my window was attracted by the flapping curtain, which he may have taken for something edible. "If so," I remarked to myself, "two of your kind have been deceived to-night."

(To be continued.)

THE MORALITY OF HAPPINESS.

By Thomas Foster.

CARE FOR SELF AS A DUTY.

(Continued from page 96.)

BUT there is another aspect of this part of our subject which requires careful attention. We have already touched on the effects which would follow if all the members of society in their zeal for the interests of others disregarded the requirements of their own health and well-being, and overlooked the effects of unwise neglect of self on the interests of their descendants and therefore of the society of which their descendants would form part. Nor in considering this aspect of the subject, have we been dealing with imaginary evils, seeing that many of the defects of the body social at the present day can be clearly traced to such misdirected, though well-meaning, efforts on the part of the better sort in past ages.

But when we consider the mixed nature of all communities, the mischief of ill-regulated disinterestedness as compared with far-seeing consideration of the interests of family, race, and nation, becomes more obviously a matter of practical moment.

If *all* men sought the good of others before their own it is obvious that a confusion of interests would arise,—other but not less unsatisfactory, perhaps, than that which exists in a society where, let their doctrines be what they may, the greater number seek their own welfare first. If, on the other hand, *all* men were moved by far-seeing considerations and a well-regulated care for the interests of others, no special care would be needed, and few rules would have to be laid down, to ensure the progress and happiness of the community. But, as a matter of fact, neither one nor the other state of things exists. The body social as at present existing may be classified, as regards care for others and self-seeking, into the following principal divisions:—

A. First there are those who in precept, and as far as they can in practice also, think of others before themselves, who repay injuries by benefits, answer reviling by blessing, and adopt as their rule the principle that those who injure and hate them are those whom they should chiefly love and towards whose well-being their efforts should be chiefly directed. This class is very small; it is always losing members, but is probably increased by fresh accessions about as fast as it is diminished by those who leave it.

B. Secondly, there are those who, having for their chief aim the well-being of those around them and of mankind generally, yet recognise as necessary even for the advancement of that object, a due regard for the well-being—the health, strength, cheerfulness, and even the material prosperity—of self.* This class like the first is small; but steadily increases in every advancing community.

C. Thirdly, come those who in all societies, at present, form far the greater part of the community,—those, viz., who think chiefly of their own interests or their families', yet, though not specially careful to increase the happiness of others, are not selfishly intent on their own well-being only.

D. Fourthly, there are those who think solely of themselves, or if they look beyond themselves care only for their nearest kinsfolk, consciously disregarding the interests of others, and seeking only in the struggle for life the advancement of themselves or their families.

E. Lastly, there are those who in their struggle to advance self are prepared to prey on others if need be, in other words wilfully to do mischief to others for their own advantage.

* One or two correspondents whose letters have been handed to me, seem still unable to dissociate the idea of self-regard from the idea of selfishness, and imagine the man who duly cares for his own well-being (as the only effective way of fitting himself to be useful to others) to be necessarily one who really has at heart only his own comfort. It might be shown that the man who selfishly seeks his own comfort really goes the worst possible way to secure his own happiness. But apart from this, such a man is not the man of whom I am speaking. I am inquiring what the man should do who really wishes to increase the happiness of those around him most effectively; and I show how his care for their happiness involves, if he is wise, a due regard for his own happiness and well-being also—and even primarily, because his existence and his fitness to do good necessarily came before the good he may be able to do.

One correspondent asks whether a man who could save life at his own peril, ought not, according to the views I have indicated, to consider whether his life might not be of greater value to the community than the life which he could save by sacrificing or endangering his own? I may remark in passing that the man who most freely acknowledged, as a matter of pure reasoning, that in such a case he ought to weigh his own life's worth against the worth of that other life, would probably be the first to risk his life for others; while the man who made cheap parade of his readiness to sacrifice his life would probably be the readiest to slink away at the moment of danger. We are not considering, however, what men should do under sudden impulse of danger affecting others—and especially the weak and tender. If we were we might point out that in such cases there is much more at issue than the mere value of the lives at

In this classification we consider only the actual conduct of the various orders, not their expressed opinions. Were these to be taken into account the classification would remain nominally unchanged, but the numbers belonging to the different classes would be very much altered. Most of the members of the body social in civilised and especially in Christian countries would be assigned in that case to Class A,—though every one knows that in reality this class is a very small one indeed. Class B would be scarcely changed in number, because while members of that class are ready to maintain that the views on which their conduct depends are in their opinion sound and just, these views are not such as the members of other classes are anxious to simulate. They are not popular views — like the self-sacrificing ones which so many pretend to hold but by no means really act upon.

It is tolerably obvious that the wellbeing of society as a whole requires that classes D and E shall not be unduly large compared with the whole number of the community. Whatever tends to diminish their number, and especially the number of class E must tend to increase the wellbeing, that is the happiness, of the social body. Class C, which always constitutes the main body, merges by insensible gradations into class D, and class D into class E. Comparatively slight changes, influences relatively unimportant, suffice to transfer large numbers from the indifferent class C to the self-seeking class D, and similarly slight changes may suffice to transfer many from the simply self-seeking class D to the noxious class E. The lines of distinction between the first three classes are more marked. Members of the first class are more apt, at present, to pass into the third class than into the second, though little, it should seem, is needed to make these (the self-forgetting, enemy-loving members of the community) pass into the section combining due care of self with anxious desire to increase the happiness and well-being of the social body. That any members of the second class should pass either into the first, whence most of them came, or into the third whose indifference to the welfare of others is unpleasing to them, or into the fourth whose selfishness is abhorrent to them, is unlikely; for which reason, this class should logically have occupied the first place, seeing that the class we have set first really merges both into the second and into the third, which should therefore be set on different sides of it. We had a reason however, which many will understand, for not depriving class A of the position it holds theoretically,—though practically the class has no such standing, and is especially contemned by class C, the noisiest in pretending to accept its principles.

Since, then, the welfare of the body social depends mainly on the relative smallness of classes D and E, the selfish and the noxious, it follows that an important if not the chief duty to society, for all who really and reasoningly desire the well-being and progress of the community, is so to regulate their conduct as to cause these classes to become relatively smaller and smaller. Conduct which can be shown to encourage the development of these classes, to make selfish ways pleasanter and noxious ways safer, is injurious to the body social, and is therefore *wrong;* while on the contrary conduct which tends to increase relatively the number of those who are considerate of the welfare of others, is beneficial to the community, tends to increase the happiness of the greater number, and is therefore right. If therefore it can be shown that the principle adopted by class A, however self-sacrificing, must tend to work far wider mischief in encouraging the development of selfishness and wrong-doing, than it can possibly effect in the way of good (the good being local and casual, the evil systematic and wide-spread), then will it become clear that the principle adopted by class B, which equally seeks the good of others but entirely avoids the risk of encouraging the selfish and the evil-disposed, is that which can alone lead to permanent improvement and happiness in the social body.

This, as we shall now proceed to show, is unquestionably the case.

(To be continued.)

stake. If I saw a child weak-minded, crippled, of small worth as a member of the body social, in danger from which I could save it at the risk or even the certainty of losing my own life (which I might judge of more value to the community), I trust that whether I had to act on impulse or after reflection, I should act, *not* as weighing the value of that life against my own, but rather as considering what would be the evil influence of cowardice and meanness in a community. If I had time to reason I might reason that whatever value my life might have, must go but a small way to counterbalance the effect of evil example.

In many cases, however, men are bound first to think of the value of their life: they do so even in cases where eventually they know that their life must be sacrificed. The captain of an endangered ship, for instance, cares for his own life more than for the life of any on board, *while* his skill and experience are necessary to save life; and his actions in detail might under conceivable circumstances seem suggestive of mean care for his own life, when he knows at the very time that, after he has seen off the last boat—perhaps before many minutes are past—he and his best officers must go down with the ship.

It is singular and significant, however, that cavils such as I have here touched upon, come without a single exception in letters otherwise so worded as to show inexperience, deficiency of reasoning power, or that turn of mind, unfairly regarded as specially belonging to the weaker sex, which does not reason at all but simply repeats parrot-like, and with constant reference to the last word, the maxims (often quite misunderstood) learned by rote in childhood.

THE CHEMISTRY OF COOKERY.

XXIX.

By W. Mattieu Williams.

NEXT to the enveloping tissue, the most abundant constituent of the vegetables we use as food is starch. Laundry associations may render the Latin name "*fecula*," or "*farina*," more agreeable when applied to food. We feed very largely on starch, and take it in a multitude of forms. Excluding water, it constitutes above three-fourths of our "staff of life;" a still larger proportion of rice, which is the staff of Oriental life, and nearly the whole of arrow-root, sago, and tapioca, which may be described as composed of starch and water. Peas, beans, and every kind of seed and grain contain it in preponderating proportions; potatoes the same, and even those vegetables which we eat bodily, all contain within their cells considerable quantities of starch.

Take a small piece of dough, made in the usual manner by moistening wheat flour, put it in a piece of muslin and work it with the fingers under water. The water becomes milky, and the milkiness is seen to be produced by minute granules that sink to the bottom when the agitation of the water ceases. These are starch granules. They may be obtained by similar treatment of other kinds of flour. Viewed under a microscope they are seen to be ovoid particles with peculiar concentric markings that I must not tarry to describe. The form and size of these granules vary according to the plant from which they are derived, but the chemical composition is in all cases the same, excepting, perhaps, that the amount of water associated with the actual starch varies, producing some small differences of density or other physical variations.

Taking arrowroot as an example. To the chemist arrowroot is starch in as pure a form as can be found in nature, and he applies this description to all kinds of arrowroot;

XUM

but, looking at the "price current" in the *Grocer* of the current week (Feb. 16), I find, under the first item, which is "Arrowroot," the following:—"Bermuda per lb., 1s. to to 2s;" "St. Vincent and Natal, 2¼d. to 8½d.;" and this is a fair example of the usual differences of price of this commodity. Nine farthings to 96 farthings is a wide range, and should express a wide difference of quality. I have on several occasions, at long intervals apart, obtained samples of the highest-priced Bermuda, and even "Missionary" arrowroot, supposed to be perfect, brought home by immaculate missionaries themselves, and therefore worth three-and-sixpence per pound, and have compared this with the twopenny or threepenny "St. Vincent and Natal." I find that the only difference is that on boiling in a given quantity of water the Bermuda produces a somewhat stiffer jelly, the which additional tenacity is easily obtainable by using a little more twopenny (or I will say fourpenny, to allow a good profit on retailing) to the same quantity of water. Putting it commercially, the Natal, as retailed at fourpence per lb., and the Bermuda at its usual retail price of three shillings, I may safely say that nine ounces of Natal, costing twopence farthing is equal to eight ounces of Bermuda, costing eighteenpence. Both are starch, and starch is neither more nor less than starch, unless it be that the best Bermuda at three shillings per lb. is starch *plus* humbug.

The ultimate chemical composition of starch is the same as that of cellulose—carbon and the elements of water, and in the same proportions; but the difference of chemical and physical properties indicates some difference in the arrangement of these elements. It would be quite out of place here to discuss the theories of molecular constitution which such differences have suggested, especially as they are all rather cloudy. The percentage is—carbon 44·4, oxygen 49·4, and hydrogen 6·2. The difference between starch and cellulose that most closely affects my present subject, that of digestibility, is considerable. The ordinary food-forms of starch, such as arrowroot, tapioca, rice, &c., are among the most easily digestible kinds of food, while cellulose is peculiarly difficult of digestion; in its crude and compact forms, it is quite indigestible by human digestive apparatus.

Neither of them are capable of sustaining life alone; they contain none of the nitrogenous material required for building up muscle, nerve, and other animal tissue. They may be converted into fat, and may supply fuel for maintaining animal heat, and may supply some of the energies demanded for organic work.

Serious consequences have resulted from ignorance of this, as shown in the practice of feeding invalids on arrowroot. The popular notion that anything which thickens to a jelly when cooked must be proportionally nutritious is very fallacious, and many a victim has died of starvation by the reliance of nurses on this theory, and consequently feeding an emaciated invalid on mere starch in the form of arrowroot, &c. The selling of a fancy variety at ten times its proper value has greatly aided this delusion, so many believing that whatever is dear must be good. I remember when oysters were retailed in London at fourpence per dozen. They were not then supposed to be exceptionally nutritious and prescribed to invalids, as they have been lately, since their price has risen to threepence each.

The change which takes place in the cookery of starch may, I think, be described as simple hydration, or union with water; not that definite chemical combination that may be expressed in terms of chemical equivalents, but a sort of hydration of which we have so many other examples, where something unites with water in any quantity, the union being accompanied with an evolution of some amount of heat. Striking illustrations of this are presented on placing a piece of hydrated soda or potash in water, or mixing sulphuric acid, already combined chemically with an equivalent of water, with more water. Here we have aqueous adhesion and considerable evolution of heat, without the definitive quantitative chemical combination demanded by atomic theories.

In the experiment above described for separating the starch from wheat flour, the starch thus liberated sinks to the bottom of the water and remains there undissolved. The same occurs if arrowroot be thrown into water. This insolubility is not entirely due to the intervention of the envelope of the granules, as may be shown by crushing the granules, *while dry*, and then dropping them into water. Such a mixture of starch and cold water remains unchanged for a long time—Miller says "an indefinite time."

When heated to a little above 140° Fah., an absorption of water takes place through the enveloping membrane of the granule, the grains swell up, and the mixture becomes pasty or viscous. If this paste be largely diluted with water the swollen granules still remain as separate bodies and slowly sink, though a considerable exosmosis of the true starch has occurred, as shown by the thickening of the water. It appears that in their original state the enveloping membrane is much folded, the folds probably forming the curious marking of concentric rings, which constitutes the characteristic microscopic structure of starch granules, and that when cooked, at the temperature named, the very delicate membrane becomes fully distended by the increased bulk of the hydrated and diluted starch.

A very little mechanical violence, mere stirring, now breaks up these distended granules, and we obtain the starch paste so well known to the laundress, and to all who have seen cooked arrowroot. If this paste be dried by evaporation it does not regain its former insolubility, but readily dissolves in hot or cold water. This is what I should describe as cooked starch.

Starch may be roasted as well as boiled, but with very different effects. The changes that then occur are much more decided and very interesting. I will describe them in my next.

WILD BEES.

By S. A. Butler, B.A., B.Sc.

(*Continued from page* 100.)

SOMETIMES there may be found on the bodies of bees a curious little orange-coloured six-footed creature about one-tenth of an inch long, This is the young larva of a great, fat, lazy beetle, the Oil Beetle, so called from a nasty habit it has of causing drops of an oily fluid to exude from its joints whenever it is handled. The perfect beetle may frequently be seen lazily scrambling along over the grass in our fields. It is a bluish-black, flabby creature, with an abdomen of proportions quite aldermanic. It is not easy to understand what the larvæ of these beetles can want on a bee's back; but in some instances, at any rate, on being carried to the nest, they fall to on the larva of their host, and enrich themselves at its expense.

The humble-bees, or dumbledors, which constitute the genus *Bombus*, are subject to the parasitism of certain two-winged flies. The grubs of one of these live actually inside the bodies of the bees. Another is called *Volucella bombylans;* it is a beautiful creature, presenting a superficial resemblance to the bees in whose nests it lives; but the most curious fact about it is that its colour varies with the species on which it is parasitic. When

it lives with a yellow-banded white-tailed bee, it is itself yellow-banded and white-tailed; but when the host has a red tail and no yellow band the fly also is furnished with a like colouration. The fly-grubs devour the bee-grubs, and sometimes almost clear out the nest. But the *Bombi* are subject to more insidious parasitism than even that of *Volucella*; certain *bees*, almost the exact counterparts of the *Bombi*, but differing in having no brush of hairs on their legs for the collection of pollen, live with them like the wasp-like cuckoo bees before-mentioned, and their grubs feed upon the store of nutriment laid up by the industrious hosts for their own progeny. Notwithstanding their "sponging" habits, these parasites live quite amicably with their hosts; who may, indeed, be unable to distinguish them from the legitimate owners of the nests.

Wild bees are either solitary or social. The solitary species live each in its own nest, while those that are social form larger or smaller communities, living in a single nest. Solitary bees may be, and often are, gregarious—that is, many burrows are found very near together, in the same bank, for example, but these are all separate abodes, and the inhabitants are all independent of one another. Amongst the solitary species there is, as I have already implied, a great diversity of habits. The burrows of the Plastering bees are adorned with layer upon layer of a

Fig. 2 *bis*.—Tongue of Plastering Bee.

most delicate membrane, something like gold-beater's skin, but much thinner; this is secreted by the insect itself, which uses its curiously-shaped tongue (Fig. 2) as a kind of trowel to plaster the secretion over the sides and end of its burrow. The Leaf-cutters (Fig. 7) line their nests with fragments of leaves, which they cut from various shrubs and trees. The cylindrical burrow having been prepared in sand,

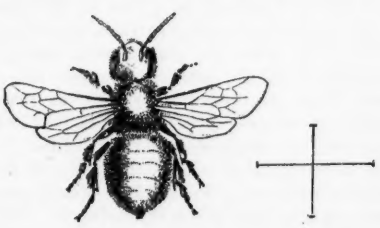


Fig. 7.—Megachile centuncularis. A Leaf-cutter Bee.

earth, or wood, as the case may be, the little labourer flies away to its chosen shrub—say a rosebush. It alights upon a leaf, and, fixing itself upon the edge, holds it with three legs on each side, and then with its mandibles begins to snip out an oval or semicircular cutting, biting its way backwards and holding on all the time to the piece, which is thus gradually detached. When the last bite is given, and the insect is about to fall with its prize, it spreads its wings and flies away in a "bee-line" to its home, where the leaf-cutting is duly deposited in a suitable position. Straight back again to the same plant the industrious creature flies, and in the same way makes another cutting, slightly altering the shape according to the requirements of the burrow. This is placed so as to lap slightly over the piece first placed in position, and then another and another is added, until the whole cell is made snug and comfortable for the reception of the egg and the food the young grub is to eat; then the cell is closed up with a number of circular leaf-cuttings, all obtained in the same way as before.

Like the Leaf-cutters, the Mason Bees are stoutly-built insects; their habits are very various, so much so, indeed, that they have been said to manifest greater diversity of instinct than any other group of bees. There is not that constancy in the choice of a situation for the construction of the nest that we find in most of the other groups. For example, the commonest species, *Osmia rufa*, exhibits a wonderful power of adapting itself to circumstances; in hilly country, or at the seaside, it often burrows in the sunny side of cliffs and in sandy banks, but in a cultivated district, especially when the soil is clayey, it will seek out some old willow tree and make its burrow in the decaying stump. Much more difficult situations are, however, not unfrequently chosen, *e.g.* the mortar of old walls. Nor does the insect always excavate its own burrow; it sometimes avails itself of some cleft or crevice already made; thus, its nests have been found in the lock of an out-house door and in a cavity in a flint used in the rockwork of a garden; but, most extraordinary of all, a nest was once formed in the tube of a fife that had been left in a garden arbour. When the fife was found, no less than fourteen cells had been made by the industrious little creature, and the fifteenth had been commenced; the bee had entered the fife at the lower end, and commenced its cells a little below the blow-hole. Some species form their nests in old snail shells, arranging the cells in different ways, as necessitated by the varying diameter of the whorls of the shell. Others, again, choose as a nidus the hollow straw-tubes in thatch, or a bramble stick from which the pith has been extracted. The cells are made of little particles of earth, stone, or other materials, agglutinated together by a gummy substance secreted by the insect itself. Both Leaf-cutters and Masons have the under surface of the abdomen densely clothed with pubescense, and with this brush of hairs they collect the pollen required for the support of their young.

The economy of the social bees is exceedingly interesting; the great buzzing, humble bees that are seen in the warm days of spring rifling the sallow blossoms, or calmly cutting their way through the air with self-satisfied hum, are the females, which have remained in a torpid state through the winter months, but have been revivified and brought forth from their retreats by the enlivening rays of the sun, as it daily mounts higher and higher in the heavens. The troubles of maternity are before them; and after they have made selection of a convenient cavity for the nest, a store of pollen has to be provided to meet the wants of the expected offspring. In addition to this, the parent bee constructs a number of receptacles called honey-pots, which she fills with a coarse kind of honey, the use of which is not certainly known. Then a few eggs are laid, which soon hatch, and the little creatures speedily pass through their metamorphoses; these are the neuters, or workers, and upon them now devolves the labour of enlarging the nest according to the needs of the community, as well as of providing for the wants of their future companions. It is

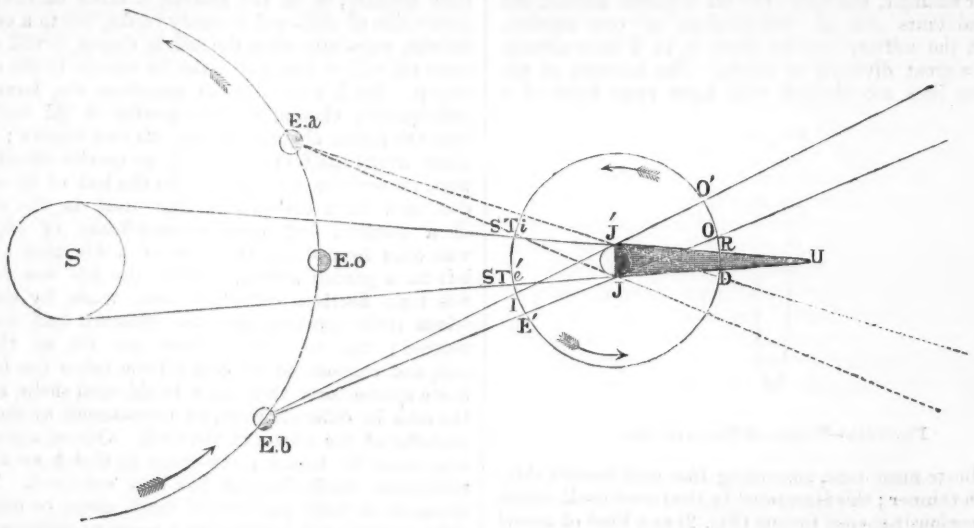
not till the season is considerably advanced that young females appear, and these are followed after a time by the males. The females are often very much larger than either the males or the workers, and sometimes the latter are exceedingly diminutive, when compared with the mother of them all. Some of the Bombi construct their nests on the surface of the ground, and others at some depth underneath, and it is a remarkable fact that this difference of habit is accompanied by a difference of temperament in the insects, the underground builders being much more pugnacious and vindictive that those that build at the surface. The nests of the latter consist of piles of little bits of grass, moss, &c., collected with great assiduity, and arranged with considerable care and skill by the little artificers. Occasionally they will adapt birds' nests to their requirements, apparently turning out the real owner, sometimes even after its eggs have been laid. The number of bees constituting one community of course varies with the season, being greatest in the autumn, when all the sexes are found. At this time the nest of one of the carder bees has been found to contain about 120 specimens, of which about half were workers. In no case is the population anything like so dense as with the hive-bee. It may be as well to mention that honey-comb is not manufactured by any of our wild bees.

JUPITER IN A THREE-INCH TELESCOPE.

By a Fellow of the Royal Astronomical Society.

(*Continued from page* 102.)

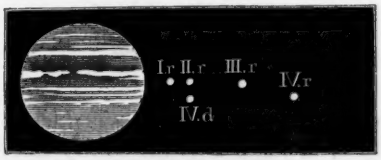
BEAUTIFUL and remarkable as are the unstable details which diversify Jupiter's face, they are, in one sense, almost monotonous as compared with the perpetually-changing phenomena of the four moons which circle round him. Of these satellites the first, second, and fourth appear as stars of the seventh magnitude, and the third as a sixth magnitude star. When a satellite crosses Jupiter's face, it is said to "transit" him; its entry on to his disc being called its ingress, and the instant of its leaving his opposite limb its egress. When it passes actually behind the planet it is said to be "occulted;" and when it plunges into his shadow, to be "eclipsed." We are unwilling to introduce anything into these papers not strictly within the scope embraced by their title; but in order to render what we are about to describe intelligible, it will be necessary to enter into certain elementary explanations of the conditions under which we view Jovian phenomena from our terrestrial standpoint. Leaving, then, our telescope for a few minutes, let S in our figure be the sun, E*b*, E*o*, E*a* the earth travelling round him in the direction of the curved arrow; J, Jupiter also going round the sun in the same direction, but so much more slowly that—for our present purpose—we may regard him as standing still. Then, evidently, Jupiter will cast the conical shadow JUJ′ out behind him into space. Let us call D, R, ST*i*, ST′*e*, the orbit of one of his outer satellites, and conceive it to coincide with the plane of the ecliptic. From E*b* draw the lines E*b*J, E*b*J′ meeting the path of the satellite at I and E′. Now, imagine the earth at E*b*, *i.e.*, before Jupiter comes into opposition (say about the end of last November). Then, when a satellite is at the point I in its orbit on the line E*b*J′, it is seen to enter on to Jupiter's eastern limb, and, when it arrives at E′, to leave his western limb. This,



then, is a Transit of the Satellite. A glance at the figure will show that (independently altogether of the earth's position) when this same satellite passes between the points ST*i* and ST′*e* its shadow must be projected on to Jupiter's face, just as the shadow of our own moon is projected on the earth in an eclipse of the sun, and it is seen to cross the planet as a round, black spot. Furthermore, when the satellite plunges into the planet's shadow at D, it disappears in eclipse, to reappear (under the conditions we are supposing) at R. It will, however, be noted that this reappearance from eclipse is only to be followed by occultation behind the body of Jupiter when the satellite reaches O, the satellite finally reappearing at Jupiter's opposite limb when it reaches O′. What we have said, be it remarked, applies only in its entirety to the two outer satellites. The inner ones, which describe smaller circles round the planet, disappear in eclipse, to reappear *from occultation*, as they emerge from the actual shadow behind the body of the planet. It will be further remarked that while the shadow of the satellite enters on to Jupiter's face when the satellite reaches the point STi; the satellite itself does not follow it on to the limb of the planet, to a terrestrial observer, until it arrives at the point I in its orbit. Thus, to sum up, before opposition,

the shadows precede the satellite casting them, in their transits; the inner satellites suffer eclipse and re-appear from occultation, and the outer satellites may both disappear and re-appear from eclipse on the western side of the planet to be subsequently occulted by it. When Jupiter is actually in opposition (*Eo* in our figure), evidently the satellites will be actually superposed on their shadows as they cross the disc of the planet; and, as the whole of the shadow cone is hidden behind him, occultations only, and no eclipses, can take place. After opposition, as at present (a condition of things represented at *Ea* above), the sequence of phenomena is obviously reversed, the satellites precede their shadows over Jupiter's face; the inner satellites are occulted by the planet, and re-appear from eclipse; and the outer satellites may disappear in, and re-appear from, occultation to be subsequently eclipsed. The student will now be prepared to understand that when our sketch of Jupiter was made on the night of Jan. 24, the planet having passed opposition a few days previously, Satellite I., which was about to leave his disc, after crossing it in transit, was slightly in advance of its shadow. In fact, the shadow did not leave his limb for seven minutes after the satellite had quitted it. Near quadrature an outer satellite may have left the planet's face for an hour or two before its shadow even enters on to it! The annexed two small diagrams represent, approximately to scale, the points of disappearance in and re-appearance from eclipse of the four satellites as seen in an inverting telescope during the months of December, 1883, and February, 1884. After what we have said, they ought to be perfectly intelligible.

Eclipses of Jupiter's Satellites (Dec., 1883).



Eclipses of Jupiter's Satellites (Feb., 1884).

It only remains, in conclusion, to refer to certain curious phenomena, for which the observer should always be on the alert. In the case of occultations, to begin with, the satellites have been seen apparently projected on the planet's disc; although it seems probable that they were rather seen *through* Jupiter's limb. A star occulted by Jupiter has been seen, in a very large telescope, to fade away in a manner which affords strong confirmation of this idea. When a satellite begins its transit, it may be traced fairly on to the planet as a brilliant spot; but it generally disappears after getting some distance within the limb, its re-appearance happening as it is about to pass off on the other side of the planet. We have said that a satellite "generally" disappears when well within the planet's limb; but very remarkable exceptions indeed to this rule have been witnessed.

We have ourselves seen Satellite III. quite as dark in appearance as its own shadow when transiting Jupiter, and the same effect has been noticed with IV., and even, more rarely, with II. Again, the shadows, although normally like ink-spots, have been seen of curiously diversified colours. Those of Satellites I. and II. have been noted as grey. Noble saw the shadow of II. a chocolate brown in October, 1880, and attempted to account for this phenomenon by the supposition that the sun's light must have been shut off from a part of Jupiter's surface glowing with a dull red heat! But, as we remarked in connection with the phenomena of the belts, our object here is not to give a mere list of prior observations, but rather to direct the beginner in his own. Under any circumstances we would fain hope that we have said enough to stimulate him to pursue the study of so interesting a system as that of which we are treating, and to impress him with something of the charm and pleasure of the investigation of the leading characteristics of the Jovian system, even in a three-inch telescope.

MADNESS AND MARRIAGE.*

THE *Medico-Legal Journal* number for December which has just reached us contains much interesting and suggestive matter in relation to the insane. The following passage is worth careful consideration:—

"MARRIAGE OF THE INSANE.—Dr. C. H. Hughes, of St. Louis, says: that marriage of all insane persons at certain ages should be interdicted by law, and the victims also of such diseases as entail insanity or epilepsia, should also be forbidden to enter into matrimony before the sterile time. In behalf of the rights of the insane, who would wish to have a maimed offspring, if under the dominion of their right reason, it should be lawful for proper persons to forbid such disastrous banns, and the duty of the State to prevent them? It is a terrible thing for the State to tacitly consent to such deterioration of the race as is caused by such marriages; and duty to humanity, sane and insane, demands repressive legislation. No "pestilence that walked in darkness, or destruction that has wasted at noon-day," ever called more loudly for State intervention against their spread, than the distinctive heritage of the neuropathic diathesis" [which we may call nerve-taint, for convenience] "calls for the concern of the State. Its evil influences are all about us, even more disastrous than any plague or pestilence, afflicting the humblest citizen as well as the highest, and their posterity.

[We may remark in passing that there would seem to be a comic compositor among those who attend to the *Medico-Legal Journal*. In one place "Folie Circulaire" is altered into "Folio circulaire," in another we learn that "a proper regard for the rights of the insane before the law should secure for them rulings by courts in accordance with the nature of their *melody*."]

As water may be said to be the chief source of wealth in Australia, the following telegram from the officer in charge of borings at Bourke, in New South Wales, is, says the *Engineer*, important:—"We have struck a further supply of fresh water in Bore B, No. 3, at a depth of 192 ft., in a layer of granite pebbles and boulders. This water is quite distinct from that struck at 122 ft. We have not yet gauged the quantity, but the water has risen 10 ft. over the surface in pipes. We are of opinion that we are only coming on the main water-bearing strata, and will have a greater supply when the bore gets deeper into the gravel bed."

* Published by the *Medico-Legal Journal* Association, 128, Broadway, New York.

WHO INVENTED THE TELEPHONE?

By W. Slingo.

THIS question is one which has lately caused considerable excitement in electrical circles, and is one upon which large financial interests depend. Although the financial side of the question is not one which concerns us to any great extent (nor for the matter of that is the claim for priority of invention *in the abstract*), nevertheless, the issue is so important in its bearings upon our social system, that the impulse to call attention to very recent revelations is irresistible. Professor S. P. Thompson has struggled very hard to prove that Reis invented, twenty years since, a telephonic system embracing the features of the Bell and Edison patents. Supposing, however, that the evidence in favour of Reis lacks convincing power, such a charge against the claims of a later worker are and have been declared by an American Court, against whose decision there is said to be no appeal, to be untenable.

The *Electrical Review* for the 16th inst. contains a communication from the States, in which a long account of the productions of the new claimant, Daniel Drawbaugh, are given. It appears that The People's Telephone Company (New York), in defending an action commenced in April, 1881, for infringement by the American Bell Telephone Company, assert Daniel Drawbaugh to be the

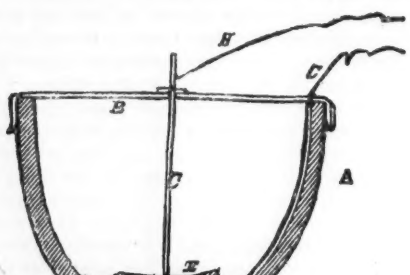


Fig. 1.

first and original inventor, and that he is entitled to the broadest possible patent for the telephone and the art of telephony. One hundred and forty-five witnesses have "identified certain telephonic instruments which they had seen and heard talk in Drawbaugh's shop from 1867 to 1876" (the year in which Bell's first patent was taken out), and two experts have testified "that the Drawbaugh talking machines were electric speaking telephones, embodying and containing all the telephone inventions patented by Bell, and that they were practical working instruments, and as good articulating telephones as they had ever heard." Space cannot be spared to describe the whole of the apparatus made by Drawbaugh, but the more important instruments call for notice.

It is probably generally known amongst the readers of Knowledge that the telephone system of Bell and Edison consists essentially of a transmitter and a receiver—the former consisting of pieces of more or less loose carbon introduced into a battery circuit, and operating on the same principle as that of the Hughes' microphone. A varying current is thus sent along the line, and on arriving at the receiving station passes through a coil of wire enveloping the pole of a magnet, which pole is thereby strengthened or weakened according to the direction and strength of the current. A thin disc of iron rigidly fixed at its edges or circumference faces the magnet-pole. The magnet's strength suffering a change according to the intensity and direction of the current, the attraction of the disc varies proportionately, and so vibrating in response to every movement of the sounding-board and loose carbon at the sending end of the line, speech and other sounds are transmitted. The first piece of Drawbaugh's apparatus, antedating Edison ten years, is illustrated in Fig. 1 (a facsimile of Drawbaugh's sketch). It consists of a china teacup, A, with a flexible membrane, B, stretched over the top. A metal rod, C, extends from the membrane to a metal plate, E, resting on a mass of powdered material, F (several substances were tried, but charcoal and other forms of carbon were eventually adopted as giving the best result), under which is another metal plate, D, connected to the wire, G. The current from the battery enters at G, passes through D, F, E, C, to the line wire, H. Drawbaugh's

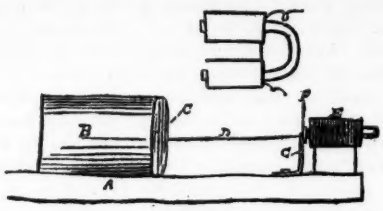


Fig. 2.

early receiver is represented in Fig. 2, in which B is an old mustard can fastened to a board, A. E is an electro-magnet whose coil is connected with the line wire. In front of the coil is an iron armature supported on a spring, G, and carrying a string, D, attached at its other end to a membrane, C, stretched across the end of the can, B.

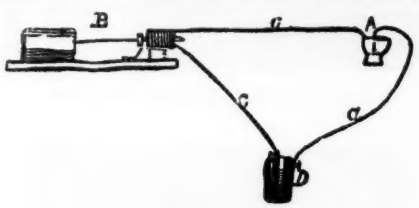


Fig. 3.

The whole arrangement is represented in the facsimile sketch Fig. 3, in which D is the battery and A the cup containing the carbon, which, by offering a varying resistance to the passage of the current, varies the strength of that current. B is the receiver at the distant end of the line.

Several modifications were made, including the application of a wooden mouthpiece to the transmitter (an exact antetypye of those now in use) and the suppression of the string in the receiver, the armature plate being attached direct to the membrane.

In 1870, Drawbaugh had found out that the telephone could be made to operate without a battery by substituting permanent magnets for electro magnets. An iron diaphragm was adopted, and a telephone (which could transmit and receive speech equally well) was made in which every feature of the Bell instrument was introduced. The instrument is represented in Fig. 4, which almost explains itself. G is the magnet which carries a coil of wire with a soft iron core on each pole, opposite the cores being the iron diaphragm. D is the mouthpiece. It will be seen that the only difference between this and Bell's instrument is

that both poles of the magnet are employed. This instrument was, however, somewhat "large and cumbrous," but within a year smaller forms were made, the working parts being placed in a cylindrical box 5 in. in diameter; and in

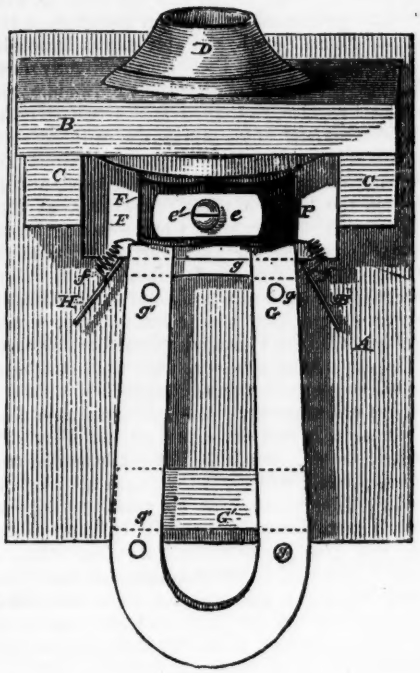


Fig. 4.

January, 1875, an instrument was made in which, by using a curled magnet, the size was reduced to 3 in. in diameter by 1½ in. thick.

Fig. 5 illustrates the progress made up to the beginning of 1876 with carbon transmitters. Here the plate diaphragm is used, and, instead of loose carbon powder, blocks

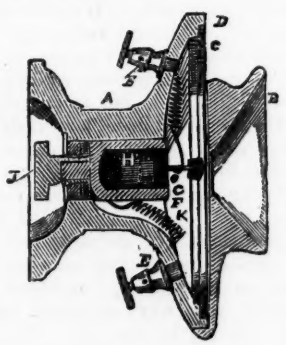


Fig. 5.

of hard gas carbon, held normally in contact by spring pressure, are employed. This is said to be an exceedingly sensitive transmitting instrument, which was, however, further improved during the same year.

Thus it may be seen that Bell and Edison were anticipated by several years. The patents granted to them in America have, if the information referred to above be correct, been declared void, and the telephone made free to all. The result upon the share market comes but little within our province, although it is worth mentioning that the shares of the Bell Company fell in one hour from 180 to 130 dols. What the effect in England will be is not yet clear, as it will have to be proved that Drawbaugh's discoveries were known here prior to 1876. For the sake of the community it is to be hoped they were.

Reviews.

HEATH'S FERN PORTFOLIO.

The first of what promises to be a splendid series of fern pictures presents the Royal Fern (*Osmunda regalis*). As this fern attains under favourable conditions a height of twelve feet, it is obviously impossible to present within the compass of a folio page a facsimile of a complete frond. But the upper part of a fertile frond here presented is of the natural size and an absolute facsimile of the subject from which it is taken. The picture is very beautiful as well as correct. Mr. Heath sends us for insertion as a paragraph a statement which (freed from the common but somewhat undignified jargon used in such cases) is to this effect:—He has forwarded to the Queen a copy of the *Osmunda regalis*, and received her thanks, through General Ponsonby. We do not understand Mr. Heath to say that this communication comments upon the accuracy and beauty of his fern-picture, either favourably or unfavourably, so that we are somewhat at a loss to know precisely *why* he wishes the statement made here. But we very willingly accede to his request.

Gossip.

Next week Knowledge will enter on a new career, bearing the same price thenceforward as the *Athenæum*, the *Academy*, and our old friend *Punch*. Enlarged to 32 pages, of which 22 pages on the average (alternating probably for convenience of binding between 20 and 24 pages) will be reading matter, Knowledge will be able far more effectively to fulfil the purpose for which it was originally intended. Now indeed that the change is decided upon, I may state that the question upon which readers were invited to express an opinion was whether Knowledge should continue to exist or not; for I had been so dissatisfied with the way in which, owing to limited space, the subjects dealt with here had to be broken up, or else the style and character of the paper altered, that I had almost decided to give up an effort which was leading to such (to me) unsatisfactory results. The communications of several hundreds of correspondents show that this feeling was fully justified. They also, and no doubt the bulk of the readers (for we may fairly assume that the correspondents represented the whole constituency of Knowledge) had felt that more space was wanted for the fulfilment of the paper's purpose. I can only regret that I had not sooner known the general feeling of readers.

We do not propose to make Knowledge hereafter more miscellaneous than it has been, but to treat the various subjects dealt with more fully and more continuously. Notices of books will appear more frequently than heretofore. Messrs. Slack, Grant Allen, M. Williams, E. Clodd, T. Foster, S. Butler, W. Slingo, and *the* Fellow of the Royal Astronomical Society (who has so long under that *nom de plume* instructed and delighted the readers

of the *English Mechanic*), will (we hope and believe) continue their serial or occasional contributions (as the case may be). The long-promised papers on Light Sifting (or Spectroscopic Analysis) will be commenced, and those on How to get Strong resumed and continued systematically till completed. The Editor will join as of yore in the work. We shall add some papers on optical and mechanical matters; and we hope fortnightly to give passages, with notes, illustrative of the work of "English Men of Letters." Our Mathematical column will alternately deal with Euclidean and Cartesian Geometry (a year's supply of each has accumulated). Whist, a subject which we find interests a great number of specially scientific readers, will be continued regularly, and usually a hand with notes illustrating the strategy of the game will appear weekly. In Chess we are anxious to return more to the method which we proposed to follow at the outset. Problems of five, six, or seven moves are not much cared for, nor are sui-mates very instructive to those players for whom we chiefly wish to cater, namely, those by whom Chess is regarded as a recreation rather than as a study. Even the examination of the leading openings, though in my opinion essential to the real enjoyment of the game, should in such a magazine as this be limited to the lines interesting to amateurs. We have suggested these considerations to the skilful player who deals with chequered fate under a fear-inspiring name. Possibly the Chess Column may hereafter be described as conducted by Mephisto (primarily) and the Editor.

Correspondence will weekly occupy a page or two more, perhaps, on the average than of yore. But we must remind some correspondents who have expressed regret because their communications have not appeared, that an editor is apt to be very roundly denounced if he allows the correspondence columns to become too numerous.

As regards Editorial Gossip, many kindly correspondents express a feeling that this should form a feature as of old in Knowledge. It is very pleasant to me that it should be so. In fact I may say that I fancy I should very soon have tired of Knowledge if I had not felt something like personal friendship for all its readers, even for those among them who hold opinions such as Knowledge strives to controvert.

We have received, too late for insertion in the present number, a letter from the Edinburgh Reviewer of Mr. Spencer's Philosophy, which shall appear next week.

We have received a note from Mr. Newton Crosland (for which we hope to find space next week) in which he expresses the mistaken idea that in our remarks last week on his pamphlet we wished to ridicule his belief. Nothing could be farther from our thoughts. We said he could not understand how, according to Newtonian astronomy, the variations of the centrifugal tendency is explained. There is no ridicule here, any more than there is self-ridicule in his remark (see his letter this week) that he cannot follow Newton's mathematical demonstration. His second letter, intended to set him right, really sets us right, as will be seen when it appears.

A correspondent of more vehemence than *vim* jeers at a supposed statement of mine that the rays of Alpha Draconis, the Pole star some 5,300 years ago, would at that time have been reflected by a horizontal mirror in latitude 30° north to the star Alpha Centauri, *quam proxime*, at the hour when the former Alpha was due north (below the Pole), the latter Alpha due south. I have made no statement of the kind. Three statements I have made in my little work on the Great Pyramid, to the following effect. *First*, at the time specified, as well as at the later date mentioned by Sir John Herschel, and adopted by Professor Piazzi Smyth, the star Alpha Draconis when northing below the true Pole shone directly down the descending entrance tube of the Great Pyramid. *Secondly*, if a horizontal surface, as that of still water, were at that time provided at the angle where the descending and ascending tubes meet, the light rays from Alpha Draconis would be sent directly up the ascending tube, and into its prolongation the Great Gallery. *Thirdly*, at the same epoch, the star Alpha Centauri when southing shone down the Great Gallery into the ascending tube. I might have added that, *fourthly*, the same surface of still water which at another hour had sent the rays of Alpha Draconis up the ascending tube into the Great Gallery, would have sent the rays of Alpha Centauri, when the star was southing, up the descending tube—so that that first magnitude star might have been seen in the daytime by an observer at the northern entrance of the descending tube—a first magnitude star seen in fact through the Great Pyramid! All this is demonstrable. What has not yet been demonstrated, and probably never will be, is that such observations were ever made. The neatness of the relations suggests that the Great Pyramid was built or in building at the time specified, and used for astronomical observations in that way. All I have said however is that if it were then being built, and the tubes and galleries were then open, they would have subserved the purposes I have indicated. On this point I am certain; as to the inference suggested by this certainty, I only have an opinion. The facts are curious any way, whether they indicate a set purpose or a merely accidental coincidence.

There are adverse opinions which tend, if reasonably considered, to strengthen rather than to weaken a man's faith in the views which have commended themselves to him as sound,—just as there are favourable opinions which seriously shake his confidence. When an adverse opinion is rudely or coarsely advanced, or is expressed in ill-chosen words, or supported by absurd reasoning, we naturally think such opposition akin rather to support. We feel at least a sense of relief that *this* man,—whether he be rude, or ill-trained, or illogical,—is not among those who share our opinions. On the other hand how distressing it is to hear our favoured views illogically or coarsely advocated! One begins at once to feel doubt whether there must not be something wrong about views which could commend themselves to a mind so ill-qualified to form a sound opinion on a question of any difficulty or delicacy. Yet relief, even in such a case as this, may be found in the recollection that so many accept opinions from others, without having in any way attempted to form them. When one who believes he believes some opinion to be sound is unfortunately moved to give a reason for holding or thinking he holds that opinion, he is bound to give bad reasons even for opinions which may be perfectly sound. We must not rashly then begin to doubt opinions merely because they are ill supported by persons manifestly unwise.

Mr. Thos. Foster, writing to the *Daily News* from Bangor, N.W., on the 22nd, calls attention to the common mistake of spelling Anglesey *Anglesea*. As he justly remarks one might as reasonably write Jersea or Guernsea. He remarks also that the name Llewelyn is very commonly

misspelt *Llewellyn*, which to a Welshman is absurd. We may add that the spelling *Welch*, *Welchman*, *Scotch* (for Scot or Scottish), *Scotchman*, are equally objectionable.

AUSTRALIAN BELIEF.—All the tribes believe that the earth is flat, and that the sky is propped up on poles. Beyond the sky is the gum-tree country, the home of spirits and ghosts. Every man has within him a *Yambo*, or spirit, which can leave his body and wander even to the gum-tree country and talk with the spirits there, or converse with the wandering ghosts of other sleepers. The state of departed souls and their doings after leaving the human body fill a great part of Australian mythology. The dead are buried doubled up, the body lying on the side, and the usual deposit is made of the personal effects of the deceased. Mr. Howitt, in the *Journal of the Anthropological Institute*.

THE INDIAN POPULATION IN THE UNITED STATES.—From a census compiled by Mr. Sherman Day in the *Overland Monthly* it appears that the Indian population in the United States numbers about 340,000. Most of them belong to the Territories. In the Indian Territory there are 79,000; in New Mexico, 36,500; in Dakota, 32,487; in Alaska, 31,000; in Montana, 20,400. Of the States California has an Indian population of 17,925; Michigan, 17,044; Wisconsin, 10,917; Nebraska, 4,174. In the Territories there are 247,312 Indians, of whom 193,631 are Agency Indians, in a total population of 1,012,091 (including Agency Indians). In the States there are 91,786, of whom 41,890 are Agency Indians, in a total population of 49,418,560.

A NEGATIVE THERMOMETER.—The ordinary mercurial thermometer is, as is well-known, based on the dilatation of bodies by the action of heat, and on the difference of dilatation between mercury and glass. A new thermometer, in which the mercury column sinks with a rise of temperature, has, however, been introduced by M. D. Latschinoff, who has based his instrument on the discovery of Kohlrausch that the co-efficient of dilatation of ebonite is greater than that of mercury. Latschinoff has made the reservoir of his thermometer of ebonite, and the result is that the level of the mercury falls in it when the temperature rises, and, on the contrary, rises when the temperature falls. A rise of 20 deg. Cent. lowers the mercury 25 millimètres. The result is curious; but ebonite is so untried a substance for thermometry, that we may be permitted to doubt if it will give accurate and constant indications with lapse of time.—*Engineering*.

QUAINT old Fuller speaking of the map-makers of his day says that "Though the greater part of their land is undiscovered, yet rather than they will have their maps naked and bald, they periwig them with false hair, and fill up the vacuum (especially towards the north) with imaginary plains of *Ung* and *Gog*, and the plains of *Bargu*." "So true is it," he adds, "what one saith wittily in the comedy, 'that Phantastes, the servant of Geographus, travelled farther beyond the Arctic circle than did ever his master.'" Although modern geographers are less imaginative, yet there are still a few regions, especially towards the poles, respecting which they must be content to say little, unless they will permit "Phantastes, the servant of Geographus" to range farther than his master has yet been able to travel. This is a case, however, in which, in the absence of exact information, it may be possible to theorise with some hope of instruction, since, though our seamen have not yet been able to push their way to the north pole they have discovered much which tends to give us an insight into the relations presented in the as yet unexamined portions of the Arctic and Antarctic seas.

THE FACE OF THE SKY.

FROM FEBRUARY 29 TO MARCH 14.

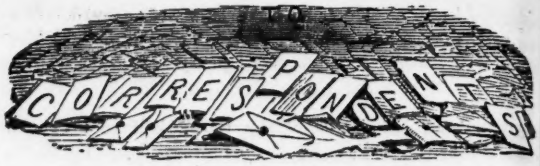
BY F.R.A.S.

THE sun continues to exhibit pretty numerous spots, faculæ, and other indications of disturbance, which should hence be looked for whenever he is visible. After sunset, the Zodiacal light may be traced as a blunt cone of faint hazy light over that part of the horizon below which he has sunk, and having its axis roughly coincident with the Ecliptic. Map III. of "The Stars in their Seasons" shows the aspect of the night sky. Mercury is a morning star, but is in a bad position for the observer. Venus is a brilliant and conspicuous object in the western evening sky, and does not set until between 9 and 10 o'clock at night. She is still gibbous in the telescope. She will be occulted by the moon a few minutes after 3 o'clock this afternoon (29th), rather more than half an hour after she has passed the meridian. At this time she will be very nearly 45° above the horizon. She will remain behind the moon for a little more than an hour and a quarter. Mars is visible all night long in the constellation Cancer (Zodiacal Map, p. 70), but his angular diameter is dwindling, and he requires a pretty powerful telescope to show much detail on his surface. Jupiter is still visible all night long, and is the chief gem of the nocturnal sky. He is, however, best seen between the hours of 7 and 11 p.m. He is sensibly stationary at a point on the confines of Gemini and Cancer (Zodiacal Map, p. 40). During the next fourteen days numerous phenomena of his satellites will occur to interest the student. Forty-three minutes after midnight to-night Satellite I. will be occulted. On March 1, the transit of Satellite I. will begin at 10h. 2m. p.m.; as will that of its shadow at 10h. 58m. The satellite will pass off at 12h. 22m. p.m.; the shadow between 1 and 2 o'clock the next morning. On the evening of the 2nd, at 7h. 10m., Satellite I. will be occulted, to re-appear from eclipse at 10h. 24m. 14s. Meanwhile, Satellite III. will re-appear from eclipse at 7h. 51m. 54s. p.m. On the 3rd Satellite I. will leave Jupiter's face at 6h. 49m. p.m., followed by its shadow at 7h. 47m. Satellite IV. will be eclipsed on the 4th at 9h. 48m. 41s. p.m. This is a phenomenon which should be carefully watched. On the 6th Satellite II. will be occulted at 8h. 36m. p.m., to reappear from eclipse between 1h. and 2m. a.m. on the 7th. On the 8th the egress of the shadow of Satellite II. will happen at 7h. 42m. p.m., and at 11h. 51m. Satellite I. will begin its transit. The shadow which it casts will not enter on to the planet's limb until 53 minutes after midnight. On the 9th Satellite III. will reappear from occultation at 7h. 41m. p.m.; only, however, to plunge in eclipse into the shadow of the planet at 8h. 23m. 44s. Satellite I. will be occulted at 8h. 59m.; and at 11h. 52m. 3s. Satellite III. will reappear from eclipse; as will Satellite I. 19m. 25s. after midnight. On the 10th the ingress of the shadow of Satellite I. on to Jupiter's disc occurs at 7h. 22m. p.m., the satellite casting it leaving his opposite limb at 8h. 38m. The shadow passes off at 9h. 42m. On the 11th Satellite I. reappears from eclipse at 6h. 48m. 10s. p.m. On the 12th Satellite IV. begins its transit at 7h. 41m. p.m., and passes off the planet's opposite limb 8 minutes after midnight. This transit, too, should be carefully watched; if possible, from beginning to end. Lastly, Satellite II. will disappear in occultation at 11 o'clock on the night of the 13th. Saturn should be looked for as soon after dark as possible, as he is steadily approaching the west. Saturn is travelling slowly towards ϵ Tauri ("The Stars in their Seasons," Map I.). Uranus may be well seen after 10 or 11 o'clock at night, now, between β and η Virginis, which last-named star he is approaching ("The Stars in their Seasons," Map V.). His pale-blue disc in the telescope will readily distinguish him from surrounding stars. Neptune has disappeared for our present purpose, until he becomes a morning star in the late autumn. The moon's age at noon to-day is 2·7 days; and quite evidently 16·7 days at the same hour on March 14. Occultations of stars by the moon are tolerably numerous during the next fourteen days. Beginning with March 3, δ^1 Tauri, a 4th magnitude star, will disappear at the moon's dark limb at 10h. 44m. p.m., at an angle of 156° from her vertex, and will reappear at her bright limb at 11h. 35m. p.m., at a vertical angle of 287°. On the same night, δ^2 Tauri, a star of the 6th magnitude, will disappear at her dark limb at 11h. 10m., at a vertical angle of 134°; reappearing at her bright limb 5 minutes after midnight, at an angle from her vertex of 308°. On the 4th, the 6th magnitude star, 115 Tauri, will disappear at the moon's dark limb at 12h. 51m. p.m., at an angle of 85° from her vertex, to reappear at her bright limb at 1h. 31m. the next morning, at an angle from her vertex of 344°. On the 6th, λ Geminorum, a star of the 3½ magnitude, will disappear at the moon's dark limb at 10h. 10m. p.m., at a vertical angle of 134°. The star will reappear at the bright limb of the moon at an angle of 262° from

her vertex at 11h. 11m. p.m. On the 8th, ε Cancri, a 5th magnitude star, will disappear at the dark limb of the moon at 10h. 18m. p.m., at an angle of 53° from her vertex, re-appearing at her bright limb at 11h. 29m. p.m. at a vertical angle of 292°. On the 10th, 34 Sextantis, a 6th magnitude star, will disappear at the moon's dark limb at 6h. 13m. p.m. at an angle of 5° from her vertex. It will reappear at 7h. 8m. p.m. at her bright limb at an angle of 243° from her vertex. Lastly, on the 11th, *v* Leonis, a star of the 4½th magnitude, will disappear at the moon's bright limb at 9h. 22m. p.m. at a vertical angle of 70°, emerging from behind the dark limb at an angle of 193° from the vertex of the moon at 10h. 25m. We have said that the emersion will take place at the dark limb; but from the moon being full only an hour or two previously, the effect will be that of emerging from an illuminated limb. The moon is in Pisces to-day; but at 7 o'clock to-morrow morning she leaves that constellation for a little corner of Cetus, which she takes about four hours to cross before entering Aries. She takes until 10h. p.m. on March 2nd to traverse Aries and enter Taurus. She continues in Taurus until 10h. a.m. on the 5th, when she passes into the extreme northern part of Orion; which, twelve hours later, she quits for Gemini. Her passage across Gemini occupies until 2 o'clock in the afternoon of the 7th, at which hour she passes into Cancer. She is travelling through Cancer until 5h. a.m. on the 9th, when she enters Leo. At 5h. a.m. on the 10th she descends into Sextans, to re-emerge at 11 o'clock the same night into Leo. She finally quits Leo for Virgo at 1h. a.m. on the 12th, and is still in the confines of that great constellation when our notes terminate.

The average expenditure on all highways in England is rather under £18 per mile; but of those managed by highway boards the cost amounts to fully £18¼. Comparing one county with another, the figures show much greater discrepancy than can be easily explained. In Devonshire the boards pay less per mile for repairs than anywhere else, excepting only in Hampshire. In these two counties the cost is as low as £9 per mile; whereas in Shropshire, which comes next on the list, it is £11, in Cornwall and Dorset £11½, and in Somersetshire £17. No other county pays much less than £20 a mile, and in Berkshire, Durham, Northampton, and Lancashire the expense is about £30. Least economical of all is Surrey, which pays £37 a mile. The cost of road metal probably explains much of this, but the *St. James's Gazette* thinks that "the expenditure seems to bear no regular proportion whatever either to the geological condition of the district, the facility of procuring materials and labour, or to any circumstance which might be expected to raise or lower the cost of road-making."

In an article on gutta-percha in the *Journal of the Society of Arts*, Mr. James Collins says:—"Dr. Oxley calculated that to supply the 6,918 piculs—1 picul equal 133⅓ lb.—exported from Singapore, from Jan. 1, 1845 to 1847, 69,180 trees were sacrificed; and, according to the *Sarawak Gazette*, 3,000,000 trees were required to supply the 90,000 piculs exported from this district during 1854 to 1874. These are only two instances, the first showing the trade in its infancy; and the second, that of a limited and comparatively small producing locality. In fact, the gutta-percha tree has only been saved from utter annihilation because trees under the age of twelve years do not repay the trouble of cutting down. Still, it is clear that the growth of young trees of the best varieties has not kept pace with the destruction, but are becoming much scarcer, so that recourse now, more than ever, has to be had to the products of very inferior varieties. At the present time there is a great difficulty in obtaining sufficient supplies of the best varieties, especially for telegraphic purposes. The Indian Government, acting on the advice of the late Mr. Howard, F.R.S., Mr. Markham, Dr. Spruce, and others, have taken up the india-rubber question. The Colonial Government should now take up the question of gutta-percha."



"Let Knowledge grow from more to more."—Alfred Tennyson.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the Editor of Knowledge; *all Business communications to the* Publishers, *at the Office, 74, Great Queen-street, W.C.* If this is not attended to delays arise for which the Editor is not responsible.

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The Editor is not responsible for the opinions of correspondents.

No communications are answered by post, even though stamped and directed envelope be enclosed.

IRELAND'S REAL ENEMIES.

[1126]—In communication 1113, page 90, allusion is doubtless made to me. Though the writer is correct in his statements (barring what he says about my "fortune") yet they may make your readers form too gloomy a picture of this sufficiently wretched country. I am not unpopular with my poor tenants in general, and they would not harm me, but I have incurred the enmity of certain rich and dishonest Land Leaguers by defeating them, and by my open opposition to illegal combination. I believe nothing but their cowardice prevents them from proceeding to extremities. But cowards are just the persons to take advantage of an opponent, say for instance when occupied in an observatory; hence it was considered prudent to abstain from star-gazing at present. If you wish it, you are quite at liberty to publish my name; it is declared war between the rebels and your humble servant,

Edward M. Richards.

THE "NEW PRINCIPIA."

[1127]—Why will you so persistently continue to misunderstand and misrepresent my Astronomical opinions? You say "Mr. N. C. thinks (I fancy) the law is wrong; for he asks somewhere what keeps the velocities up." I beg leave to reply that I do *not* think Newton's first law of motion wrong; *i.e.*, if I rightly understand a law to be a certain manifestation of phenomena under certain conditions. What I distinctly disputed was Newton's explanation of the forces which *caused* the motions of the Universe, which explanation I considered inadequate and fallacious.

I have endeavoured to show in the "New Principia" that gravitation is not, and that polarity is, a full and sufficient elucidation of all the phenomena of the movements of the planets, &c.; that Newton's facts do not support his theories, and that the phenomena of motion, which no one questions, could not be sustained if his hypothesis of their cause were accepted as conclusive. I contend that "the velocities are kept up" by polarity—*i.e.*, magnetic attraction and repulsion.

I do not quarrel with Newton's *mathematical* demonstrations. I am not competent to do so, but I step behind them, and maintain that the data upon which he constructs his system are, to the last degree, untenable and unsatisfactory. If you will study my views you will find that they are not so shallow as you imagine them to be.

I must ask you to insert this communication as a concession to truth and justice.

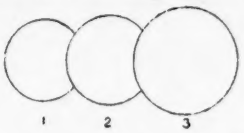
Newton Crosland.

[Mr. Crosland must not misapprehend the exceptions I have taken against the reasoning by which he conceives that Newtonian Astronomy is overthrown and the principle of polarity established. It is evident that Mr. Crosland fully believes in the strength of his position, and he is therefore quite right in asserting and re-asserting his belief that Newton's reasoning is invalid. But that his belief is altogether erroneous is so clear to every one who is competent to follow Newton's mathematical demonstration that it is impossible to speak otherwise of his views than as purely paradoxical. Every movement in the solar system, every change of velocity and corresponding change of centrifugal tendency accords *exactly* with the law of gravity. How those movements began no one is competent to say, but taking them as they exist at any moment, their future character and their observed past character for the whole time over

which astronomy extends its sway are in precise accordance with the theory that they are one and all governed by the law of universal attraction.—R. P.]

FALSE SUNS.

[1128]—I had hoped that some more competent observer than myself would have noticed and described the interesting phenomenon—mock suns I presume—which I and others of my family witnessed at sunset last Wednesday, February 6.



The subjoined diagram will serve to show the apparent positions and relative sizes of the three suns when first seen, at about twelve minutes to five o'clock, from a window which commands an almost uninterrupted view to the horizon. I suppose No. 3 was the true sun, though all were of about the same blood-red colour and equally well defined.

On the horizon, and very slightly overlapping the lower edges of the three disks, was a heavy bank of clouds, behind which they rapidly disappeared—it may have been about three minutes from the time of my first observing them; but No. 1 had then become very indistinct, Nos. 2 and 3 remaining well defined till the last.

About midway between the sun and zenith was another heavy stratum of cumuli, the intervening space being of a clear amber red, with some few light cirri floating about. I saw no halo. There was some *slight* mist in the distance. THOS. H. AMYOT.

LETTERS RECEIVED.

BOYD MOSS. The half-yearly volume will not be thicker than Vols. I. and II.—G. CLAVERING MESNARD. Quite agree with you that your solution of the Cribbage problem, (the same which two other correspondents have given) besides giving a larger total is more ship-shape than the other.—S. DE C. THOMPSON. Your former letter marked for insertion. Thanks both for that and later letter. —J. ROWE. Know of none suitable for lectures. Oddly enough your suggestion already in part adopted, pictures actually engraved, but kept out for want of space.—D. C. Many thanks for your kindly and suggestive letter. Pecuniary considerations have to be taken carefully into account. The case is akin to that considered by Mr. Foster. Existence is essential even to the best intentions. Without going so far as dear old Johnson who said that "no one but a fool would write except for money," I note that no one but a fool would so conduct literary work as to impoverish himself and those for whom it is his duty to provide. A man of large means who gives time and labour gratuitously to help in instructing or benefiting the world deserves our approval and esteem; but one who should do the same, without sufficient means, and thereby eventually deprive himself of the power of doing the good he had intended, would be regarded as unwise to say the least of it.—INNOCENT AMATEUR. Rather hard to advise. My own experience does not help; for when I wanted such a telescope as you describe, I neither bought one of the cheaper sort, nor a smaller but more expensive instrument from a leading optician, such as Dollond, Cooke, or Wray,—but first bought a good object-glass, and three eyepieces,—then having noted the focal length of the O-G, I made my own tube, of card and black calico. Afterwards, but to my eventual regret, I had this light but strong tubing replaced by a wooden hexagonal one, the only satisfaction I derived from which arose from my having planned its proportions myself and also the arrangement for the slow movements. This instrument is, or was till lately, at Marlborough College.—A LADY MATHEMATICIAN. The "we" who dealt so contumeliously with that bright luminary of yours, "were" the Editor; but by an odd coincidence the printer's devil *had* something to do with the matter, for he put that answer under the wrong heading. H. S. is *not* food for babes; but then "that fellow, F.," (as you politely call him) is not a babe, nor are "we." As your mathematical studies progress you will find it easy to see that at the time and in the latitude specified the light of Alpha Draconis would be reflected in the way we indicated. At present, it might be a useful exercise to try to prove the reverse. What you have to do is to show that the difference between the north polar distances of Alpha Centauri and Alpha Draconis was *not* at that time equal to twice the colatitude of the great pyramid. Lastly, you should note that the study of mathematics ought to have an effect rather soothing than the reverse. To illustrate this let me tell you an experience. I was once suffering torture as intense—about—as I could bear without fainting; I knew it would last several hours; and I was rather troubled at the thought; it occurred to me my beloved mathematics might help me. I was writing at the time my treatise on the geometry of cycloids, and had just reached that interesting part where the ratio of the arc of a prolate cycloid to an elliptical arc has to be geometrically demonstrated. It occurred to me that if I worked out a demonstration without the aid of pen, ink, and paper (which in my position at the time I could not use), I might bear my anguish better. The result was marvellous. After a few minutes during which the pain seemed increased, my mind went bodily off into the prolate-cycloidal country (bodily off because my body seemed forgotten). Before I returned thence I had completed mentally the solutions for about thirty pages of the sweet and light little treatise I have named. So I say of mathematics, "When pain and anguish wring the brow" (or even were it the big toe, for that matter), "a ministering angel thou." What comfort then ought not you to find in your department, which I assume to be "Lady Mathematics." Yet hitherto the case seems otherwise with you.—A LEARNER. Do not quite understand your difficulty,—that is why waves resulting from vibrations in the direction of wave motion should be harder to understand than waves resulting from vibrations transverse to that direction.—E. C. R. Doubt whether any other cause but relative dryness makes the action of the east wind so unpleasant.—R. HILTON. Under what conditions have you used your telescope? Do not rashly condemn it or dispose of it as inferior. The maker has a high and well deserved repute.—POLYGLOTT. A page on patent law clearly showing what an inventor has to do and avoid, what to expect, what to hope, and what to fear, would, I think, be of great interest to our readers.—JUPITER. 1. Not if you properly protect your eyes. 2. No influence whatever has ever been detected. 3. Jupiter's moons would serve to make the theory of the tides very difficult for future inhabitants of that planet. Would prefer to leave the problem to them. 4. Mars has two moons; but if he had none the sun would make tides. And even if he made none, Mars might may be, do without them.—J. MURRAY.—M. B. STIDSTON.—P. D. T. MYERS.—E. M. FAITHFUL. —W. B. GRAHAM.—J. RUSSELL.—R. PHILLIPS.—W. WILKINSON.—LONDON CLAY.—A. M. CHANDISS.—H. MACKLY.—CAPSTAN.—J. P. T. ASHTON.—EXPECTANT.—T. H. AMGOT.—EIN DEUTCHE. I think you *are* too "youthful" to express such opinions.—G. E. ANTI-FRICTION. —J. PEARCE.—F.R.C.S.—G. T. HARRAP.—EDWIN WOOTON. Should be glad to know what space such papers would require. The subject is important and interesting.—M. BELL. Many thanks.—MERRES.—T. H. AMYOT. Thanks.—W. MACKLY. Thanks.—W. A. T. —M. T. H.—J. MACDONALD. Thanks, you give us the kind of opinion we have sought to obtain. You are mistaken about the odd advertisement leaf; no binder of any experience would bind it in.—F. LOBURTZ.—J. W. MARTIN.—SENEX.—J. HERBERT. Thanks. —G. G. HARDRINGHAM. Thanks; suggestions noted.—J. P. T. ASHTON. Messrs. Longmans. Title of Book, "Constellation Seasons."—F. HAWKEY.—J. G. SMITH.—S. SHRIVE.—E. LEE.—J. FARRAR.—R. P. ANDERSON. Have no doubt your papers would prove most interesting; and think it likely the introduction of such matter would be most profitable for KNOWLEDGE. But it would not be fair to readers, who have a right to consider that the narrative element is not in our programme.—J. FARRAR. Unfortunately cannot work out sums here.—ANTI-FRICTION. The difference really depends not on the extent of surface in contact, but on the difference between rolling friction and sliding friction. Block the bearings, and the smallness of the surface in contact will be of no avail to reduce frictional resistance. Thanks for closing passage of letter.—LONDON CLAY. Do not think the B. A. Cat. can now be bought. My copy was borrowed. Almanack papers more suitable at longer intervals, as scattered short tables inconvenient. But, I say!—no star maps for a month? That's a large order. How long ago is it since the first and second numbers of February appeared? Surely not a month. It would not be fair just now to publish statistics on the point you mention.—C. ROUSSELET.—A. F. Science regards air as visible if in sufficient quantity.—A READER. Thanks. —J. HARRISON.—C. SOUTHALL. Thanks for your very kind and encouraging letter.—J. BARNES.—J. ROGERS. We meant one only among last week's letters, up to the time of opening that particular letter. You do not make Nos. 2 and 3 who object to the change from 2d. to 3d.: more nearly fifty-two and fifty-three. But certainly thirty times as many have voted for as against the change, and the greater number of them have so written as to make us very gravely regret that the change was not made earlier, since they point out that KNOWLEDGE has had defects which the change alone could have corrected. The probability is as you say, that hundreds oppose the change, in fact that follows as almost a certainty from the process of dividing *all* our

readers into those for and against in the proportion indicated by those who have expressed an opinion. It follows as certainly that thousands are in favour of the change. The conclusion is that we may lose several hundreds of readers. But we have confidence that in the long run as many will be brought to us through the canvassing of those whose wishes we have considered in the matter. Some write, by the way, as if a change adding only one-fourth to the expenses for paper and printing, but one-third to the price, must necessarily involve a gain to the proprietors. They overlook the circumstance that the returns from advertisements (always an important part of the proceeds) are not affected at all by the change, or if affected might be expected to be at first somewhat diminished. The change will certainly at the outset involve considerable loss. But we believe it is absolutely essential to the adequate carrying out of the plan and purpose of the paper; and finding it approved by about twenty-nine-thirtieths of our readers, we feel it to be but just to make the change.—W. G. Woollcombe. Anent Tangent Galvanometer, see Knowledge No. 58. Will measure resistance of wire for you. Supposing a certain length of wire to offer 10 ohms, another specimen of *exacty similar* wire 25 times as long will offer approximately 250 ohms. Vols. II. and III. of Knowledge contain, it is thought, more information of the kind you require than any work.—Expectant. See latter part of preceding answer. In the articles on electrical measurement and batteries (Vols. III. and IV.), calculations are made arithmetically, and algebra is systematically avoided. On this account the articles have, we hear, been used as the bases of lessons to unmathematical classes.—J. H. Wood. Your remarks are for the most part fully answered elsewhere. You ask if Knowledge would be half the size of *Nature* (as it should) if with 32 pp. we had 14 or 15 of advertisements. There is no chance of our filling 14 pp. of a 32 pp. number with advertisements; but supposing it happened we could still stand favourable comparison with *Nature*. Take our number for February 22nd, then (remembering that when our price is raised to 3d. the readable matter will be correspondingly increased) the comparison with *Nature* for February 21 would run as follows:—In Knowledge there were 13½ pp. of matter, 9 original, 3 borrowed, 1½ correspondence; *Nature* should give at the same rate for 6d. 40½ pp. of matter, 27 original, 9 borrowed, 4½ correspondence; but the page of *Nature* contains only five-sixths of ours, so that of such smaller pages there should be about 48 of matter, 31 original, 12 borrowed, and 5 correspondence. As a matter of fact the number contains 24 pp. of matter, consisting of two original reviews (of "Languages of Africa," and the "Theory of Determinants") and other apparently original matter, in all 7 pp., 4½ pp. correspondence; the rest chiefly made up of notes, borrowed reports, the titles of articles in scientific serials, with occasional very short summary of contents; and reports of scientific societies and academies, in the extremest technical language. The provision made by *Nature* for each 2d. of its price is found to be 6¾ pp. (of our size) as against 13½ in Knowledge, 2 pp. original matter as against 9 in Knowledge, and 4½ borrowed, correspondence, and reports as against almost exactly the same quantity of the same sort in Knowledge. Halving *Nature's* supply we have 10 pp. in all, of which 3½ are original, and 6½ borrowed, correspondence, and reports. We can safely promise never to give less than 20 pp. in all, of which at least 10 will always be original. Will not twice the quantity of total matter and thrice the quantity of original matter, satisfactorily answer your requirements?

Our Chess Column.

By Mephisto.

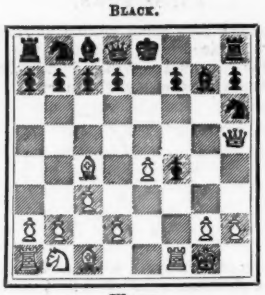
In order to gain additional experience, we have lately been engaged in some practical play, choosing Gambits whenever we had the first move. Our opponent—a reader of Knowledge, and blessed with a good memory—trumped us with our own cards, or rather variations, the result being a bad game in the opening. We then resolved to try the effect of simply varying the moves—mostly always a good expedient against inexperienced play. The result proved highly satisfactory, although it caused our opponent to remark on the artfulness of keeping the best variations up the sleeve.

The following is the game which follows the line of play in variation (*b*), p. 78:—

1. P to K4 / P to K4 2. P to KB4 / P takes P 3. Kt to KB3 / P to KKt4 4. B to B4 / B to Kt2
5. P to B3 / P to Kt5 (given as best) 6. Castles / P takes Kt 7. Q takes P / Kt to KR3
8. Q to R5. This was the novelty. In the analysis we gave 8. P to Q4. The object of this move was to be able to take the Pawn with the Rook, and, if possible, to play R to R4 after P to Q4 had been played, thus bringing three pieces to bear upon the awkwardly placed Knight, as the following position will show:—

Amateur.

Black.



White.

Mephisto.

Black here replied with 8. Q to B3, with the laudable intention of ousting the enterprising White Queen from her advanced position. We of course played 9. P to Q4, to which Black replied with 9. Q to Kt3, compelling 10. Q to R4. Here Black wanted to play too well; the Queen not wisely played 10. Q to Kt5, to which we were enabled to reply with 11. B takes P (ch) / K takes B 12. R takes P (ch) with a won game.

Of course K takes B was a blunder, but in any case White had a fine game, as, per example, if instead of K takes B, 11. K to B sq. 12. Q takes Q / Kt takes Q 13. B to Kt3. Now B to R3 would not be good on account of B takes P, nor Kt to B3, on account of P to K5. Black's best seems to be 13. P to Q3 14. R takes P (ch) / K to K sq. 15. R to B7 / B to R3 16. Kt to R3 with a good attack, for if now Black plays B to Q2 to save the Pawn and prevent Kt to Kt5, a likely continuation would be 17. P to KR3 / B takes B 18. R takes B / Kt to KR3 19. R to Kt7 / K to B sq. 20. R to Kt5, and White must win by bringing his QR into play *vid* KB sq. to B6, which Black could not prevent.

Mr. R. A. Proctor's Course of Lectures.

1. LIFE OF WORLDS.
2. THE SUN.
3. THE MOON.
4. THE PLANETS.
5. COMETS.
6. THE STAR DEPTHS.

See Advt. Pages for full Syllabus.

The following arrangements are complete: the numbers in brackets referring to above list.

TAUNTON (Victoria Rooms), March 5, 6 (1, 2).
SURBITON, Feb. 25, March 3.
BIRKENHEAD, March 10.
ALTRINCHAM, March 11 (5).
CHESTER, March 12, 13 (1, 2).
HAVERSTOCK-HILL, March 14 (2).
BLACKHEATH, March 17, 18.
REIGATE, March 19 (2).
HITCHIN, March 20 (5).
UXBRIDGE, March 21 (1).
LONDON (Brixton Hall) March 28, April 1, 4 (1, 2, 3).
" (Memorial Hall), March 24, 27, 31, April 3 (1, 2, 3, 4).
BIRMINGHAM (Town Hall), April 18, 23, 25, 28; May 2 (1, 2, 3, 5, 6).
LEAMINGTON (Royal Music Hall), Four Afternoons, April 17, 19, 24, 26 (1, 3, 5, 6); Two Evenings, April 17, 24 (2, 4).
OXFORD (Town Hall), May 12, 13, 19, 20.

Note.—*All communications respecting Lectures should be addressed to Mr. John Stuart, Royal Concert Hall, St. Leonards.*